

OBSERVATIONS & RECOMMENDATIONS

After reviewing data collected from **Cole Pond, Andover**, the program coordinators have made the following observations and recommendations.

We congratulate your group for sampling your pond **once** this summer. However, we **strongly encourage** your monitoring group to sample additional times each summer. Typically, we recommend that monitoring groups sample **three times** per summer (once in **June, July**, and **August**). We understand that the number of sampling events you decide to conduct per summer will depend upon volunteer availability, and your monitoring group's goals and funding availability. However, with a limited amount of data it is difficult to determine accurate and representative water quality trends. Since weather patterns and activity in the watershed can change throughout the summer, from year to year, and even from hour to hour during a rain event, it is a good idea to sample the pond at least once per month during the summer.

If you are having difficulty finding volunteers to help sample or to travel to one of the laboratories, please call the VLAP Coordinator and DES will help you work out an arrangement.

If your monitoring group's sampling events this year were limited due to not having enough time to pick-up or drop-off samples at the Limnology Center in Concord, please remember the Colby Sawyer College Water Quality Laboratory is open in New London. This laboratory was established to serve the large number of lakes/ponds in the greater Lake Sunapee region of the state. This laboratory is inspected by DES and operates under a DES approved quality assurance plan. We encourage your monitoring group to utilize this laboratory next summer for all sampling events, except for the annual DES biologist visit. To find out more about the Colby Sawyer College Water Quality Laboratory, and/or to schedule dates to pick up bottles and equipment, please call Bonnie Lewis, laboratory manager, at (603) 526-3486.

We encourage your monitoring group to formally participate in the DES Weed Watchers program, a volunteer program dedicated to monitoring lakes and ponds for the presence of exotic aquatic plants. This program only involves a small amount of time during the summer months.

Volunteers survey their waterbody once a month from **May** through **September**. To survey, volunteers slowly boat, or even snorkel, around the perimeter of the waterbody and any islands it may contain. Using the materials provided in the Weed Watcher kit, volunteers look for any species that are suspicious. After a trip or two around the waterbody, volunteers will have a good knowledge of its plant community and will immediately notice even the most subtle changes. If a suspicious plant is found, the volunteers immediately send a specimen to DES for identification. If the plant specimen is an exotic species, a biologist will visit the site to determine the extent of the problem and to formulate a management plan to control the nuisance infestation. Remember that early detection is the key to controlling the spread of exotic plants.

If you would like to help protect your lake or pond from exotic plant infestations, contact Amy Smagula, Exotic Species Program Coordinator, at 271-2248 or visit the Weed Watchers website at www.des.nh.gov/organization/divisions/water/wmb/exoticspecies/weed_watcher.htm.

FIGURE INTERPRETATION

CHLOROPHYLL-A

- **Figure 1 and Table 1:** Figure 1 in Appendix A depicts the historical and current year chlorophyll-a concentration in the water column. Table 1 in Appendix B lists the minimum, maximum, and mean concentration for each year that the pond has been monitored through VLAP.

Chlorophyll-a, a pigment found in plants, is an indicator of the algal abundance. Algae (also known as phytoplankton) are typically microscopic, chlorophyll producing plants that naturally occur in lake ecosystems. The chlorophyll-a concentration measured in the water gives biologists an estimation of the algal concentration or lake productivity. **The median summer chlorophyll-a concentration for New Hampshire's lakes and ponds is 4.58 mg/m³.**

The current year data (the top graph) show that the chlorophyll-a concentration was **1.23 mg/m³** in **July**.

The historical data (the bottom graph) show that the **2010** chlorophyll-a mean is ***much less than*** the state and similar lake medians. For more information on the similar lake median, refer to Appendix F.

Overall, the statistical analysis of the historical data (the bottom graph) show that the mean annual chlorophyll-a concentration has **not significantly changed** (neither *increased* nor *decreased*) since monitoring began. Specifically, the chlorophyll-a concentration has remained **relatively stable, ranging between approximately 0.38 and 1.97 mg/m³** (excluding 2005 data), which is ***much less than*** the state median, since **1994**. Please refer to Appendix E for a detailed statistical analysis explanation and data print-out.

While algae are naturally present in all lakes and ponds, an excessive or increasing amount of any type is not welcomed. In freshwater lakes and ponds, phosphorus is the nutrient that algae typically depend upon for growth in New Hampshire lakes. Algal concentrations may increase as nonpoint sources of phosphorus from the watershed increase, or as in-lake phosphorus sources increase. Therefore, it is extremely important for volunteer monitors to continually educate all watershed residents about management practices that can be implemented to minimize phosphorus loading to surface waters.

TRANSPARENCY

- **Figure 2 and Tables 3a and 3b:** Figure 2 in Appendix A shows the historical and current year data for transparency with and without the use of a viewscope. Table 3a in Appendix B lists the minimum, maximum and mean transparency data without the use of a viewscope and Table 3b lists the minimum, maximum and mean transparency data with the use of a viewscope for each year that the pond has been monitored through VLAP.

Volunteer monitors use the Secchi disk, a 20 cm disk with alternating black and white quadrants, to measure how far a person can see into the water. Transparency, a measure of water clarity, can be affected by the amount of algae and sediment in the water, as well as the natural lake color of the water. **The median summer transparency for New Hampshire's lakes and ponds is 3.2 meters.**

The current year data (the top graph) show that the non-viewscope in-lake transparency was **5.5 meters** in July and the Secchi disk was visible on the pond bottom.

The historical data (the bottom graph) show that the **2010** mean non-viewscope transparency is ***much greater than*** the state and similar lake medians. Please refer to Appendix F for more information about the similar lake median.

The transparency was not measured with the viewscope because the Secchi disk was visible on the pond bottom without the viewscope.

Overall, the statistical analysis of the historical data (the bottom graph) shows that the mean annual in-lake non-viewscope transparency has ***not significantly changed*** (either *increased* or *decreased*) since monitoring began. Specifically, the in-lake transparency has remained ***relatively stable, ranging between approximately 4.5 and 6.3 meters*** since **1994**. Please refer to Appendix E for the statistical analysis explanation and data print-out.

Typically, high intensity rainfall causes sediment-laden stormwater runoff to flow into surface waters, thus increasing turbidity and decreasing clarity. Efforts to stabilize stream banks, lake and pond shorelines, disturbed soils within the watershed, and especially dirt roads located immediately adjacent to the edge of tributaries and the lake or pond should continue on an annual basis. Guides to best management practices that can be implemented to reduce, and possibly even eliminate, nonpoint source pollutants, are available from DES upon request.

TOTAL PHOSPHORUS

- **Figure 3 and Table 8:** The graphs in Figure 3 in Appendix A show the amount of epilimnetic (upper layer) phosphorus and hypolimnetic (lower layer) phosphorus; the inset graphs show current year data. Table 8 in Appendix B lists the annual minimum, maximum, and median concentration for each deep spot layer and each tributary since the pond has been sampled through VLAP.

Phosphorus is typically the limiting nutrient for vascular aquatic plant and algae growth in New Hampshire's lakes and ponds. Excessive phosphorus in a lake or pond can lead to increased plant and algal growth over time. **The median summer total phosphorus concentration in the epilimnion (upper layer) of New Hampshire's lakes and ponds is 12 ug/L. The median summer phosphorus concentration in the hypolimnion (lower layer) is 14 ug/L.**

The current year data for the epilimnion (the top inset graph) show that the phosphorus concentration was **6 ug/L** in **July**.

The historical data show that the **2010** mean epilimnetic phosphorus concentration is ***much less than*** the state and similar lake medians. Refer to Appendix F for more information about the similar lake median.

The current year data for the hypolimnion (the bottom inset graph) show that the phosphorus concentration was **8.5 ug/L** in **July**.

The historical data show that the **2010** mean hypolimnetic phosphorus concentration is **less than** the state and similar lake medians. Please refer to Appendix F for more information about the similar lake median.

Overall, visual inspection of the historical data trend line for the epilimnion shows a **relatively stable** phosphorus trend. Specifically, the mean annual epilimnetic phosphorus concentration has **remained approximately the same** since monitoring began in **1991**.

Overall, visual inspection of the historical data trend line for the hypolimnion shows a **variable** phosphorus trend since monitoring began. Specifically the mean annual concentration has **fluctuated between approximately 3 and 22 ug/L** since monitoring began in **1991**.

Please keep in mind that these trends are based on limited data. As your group expands its sampling program to include additional events each year, we will be able to determine trends with more accuracy and confidence.

After 10 **consecutive** years of sample collection, we will be able to conduct a statistical analysis of the historical data to objectively determine if there has been a significant change in the annual mean phosphorus concentration since monitoring began.

One of the most important approaches to reducing phosphorus loading to a waterbody is to continually educate watershed residents about the watershed sources of phosphorus and how excessive phosphorus loading can negatively impact the ecology and the recreational, economical, and ecological value of lakes and ponds.

TABLE INTERPRETATION

➤ **Table 2: Phytoplankton**

Table 2 in Appendix B lists the current and historical phytoplankton and/or cyanobacteria observed in the pond. Specifically, this table lists the three most dominant phytoplankton and/or cyanobacteria observed in the sample and their relative abundance in the sample.

The dominant phytoplankton and/or cyanobacteria observed in the **June** sample were ***Merismopedia* (Cyanobacteria)**.

Phytoplankton populations undergo a natural succession during the growing season. Please refer to the “Biological Monitoring Parameters” section of this report for a more detailed explanation regarding seasonal plankton succession. Diatoms and golden-brown algae populations are typical in New Hampshire’s less productive lakes and ponds.

➤ **Table 4: pH**

Table 4 in Appendix B presents the in-lake and tributary current year and historical pH data.

pH is measured on a logarithmic scale of 0 (acidic) to 14 (basic). pH is important to the survival and reproduction of fish and other aquatic life. A pH below 6.0 typically limits the growth and reproduction of fish. A pH between 6.0 and 7.0 is ideal for fish. The median pH value for the epilimnion (upper layer) in New Hampshire’s lakes and ponds is **6.6**, which indicates that the state surface waters are slightly acidic. For a more detailed explanation regarding pH, please refer to the “Chemical Monitoring Parameters” section of this report.

The mean pH at the deep spot this year ranged from **6.35** in the hypolimnion to **6.51** in the epilimnion, which means that the water is ***slightly acidic***.

Due to the state’s abundance of granite bedrock in the state and acid deposition received from snowmelt, rainfall, and atmospheric particulates, there is little that can be feasibly done to effectively increase pond pH.

➤ **Table 5: Acid Neutralizing Capacity**

Table 5 in Appendix B presents the current year and historical epilimnetic ANC for each year the pond has been monitored through VLAP.

Buffering capacity (ANC) describes the ability of a solution to resist changes in pH by neutralizing the acidic input. The median ANC value for New Hampshire’s lakes and ponds is **4.8 mg/L**, which indicates that many lakes and ponds in the state are at least “moderately vulnerable” to acidic inputs. For a more detailed explanation about ANC, please refer to the “Chemical Monitoring Parameters” section of this report.

The mean acid neutralizing capacity (ANC) of the epilimnion (upper layer) was **2.3 mg/L**, which is **less than** the state median. In addition, this indicates that the pond is **moderately vulnerable** to acidic inputs.

➤ **Table 6: Conductivity**

Table 6 in Appendix B presents the current and historical conductivity values for tributaries and in-lake data. Conductivity is the numerical expression of the ability of water to carry an electric current, which is determined by the number of negatively charged ions from metals, salts, and minerals in the water column. The median conductivity value for New Hampshire's lakes and ponds is **40.0 uMhos/cm**. For a more detailed explanation, please refer to the "Chemical Monitoring Parameters" section of this report.

The mean annual epilimnetic conductivity at the deep spot this year was **15.9 uMhos/cm**, which is **much less than** the state median.

The in-lake conductivity has **decreased** (meaning **improved**) in the pond since monitoring began. Increases in conductivity typically indicate the influence of human activities on surface water quality. Septic system leachate, agricultural runoff, iron deposits, and road runoff which typically contains road salt during the spring snow melt, can each influence conductivity readings. This **decreasing** conductivity trend suggests the reduction of pollutants and erosion in the watershed. We hope that this improving trend continues!

➤ **Table 8: Total Phosphorus**

Table 8 in Appendix B presents the current year and historical total phosphorus data for in-lake and tributary stations. Phosphorus is the nutrient that limits the ability of algae and aquatic plants to grow and reproduce. Please refer to the "Chemical Monitoring Parameters" section of this report for a more detailed explanation.

The phosphorus concentration in the **Outlet** was **low** this year, which is good news. However, we recommend that your monitoring group sample the major tributaries to the pond during snow-melt and periodically during rainstorms to determine if the phosphorus concentration is **elevated** in the tributaries during these times. Typically, the majority of nutrient loading to a pond occurs in the spring during snow-melt and during intense rainstorms that cause soil erosion and surface runoff and within the watershed.

For a detailed explanation on how to conduct rain event sampling and stream surveys, please refer to the 2002 VLAP Annual Report special

topic article, which is posted on the VLAP website at <http://www.des.nh.gov/organization/divisions/water/wmb/vlap/categories/publications.htm>, or contact the VLAP Coordinator.

➤ **Table 9 and Table 10: Dissolved Oxygen and Temperature Data**

Table 9 in Appendix B shows the dissolved oxygen/temperature profile(s) collected during **2010**. Table 10 in Appendix B shows the historical and current year dissolved oxygen concentration in the hypolimnion (lower layer). The presence of sufficient amounts of dissolved oxygen in the water column is vital to fish and amphibians and bottom-dwelling organisms. Please refer to the “Chemical Monitoring Parameters” section of this report for a more detailed explanation.

The dissolved oxygen concentration was **high** at all deep spot depths sampled in the pond on the **July** sampling event. Typically, shallow lakes and ponds that are not deep enough to stratify into more than one or two thermal layers will have relatively high amounts of oxygen at all depths. This is due to continual lake mixing and diffusion of oxygen into the bottom waters induced by wind and wave action.

The dissolved oxygen concentration was greater than **100 percent** saturation at **0.1** and **2.0** meters at the deep spot on the **July** sampling event. Wave action from wind can also dissolve atmospheric oxygen into the upper layers of the water column. Layers of algae can also increase the dissolved oxygen in the water column, since oxygen is a by-product of photosynthesis. Considering that the depth of sunlight penetration into the water column was approximately **5.5** meters on this sampling event, as shown by the Secchi disk transparency depth, we suspect that an abundance of algae in the epilimnion caused the oxygen super-saturation.

➤ **Table 11: Turbidity**

Table 11 in Appendix B lists the current year and historical data for in-lake and tributary turbidity. Turbidity in the water is caused by suspended matter, such as clay, silt, and algae. Water clarity is strongly influenced by turbidity. Please refer to the “Other Monitoring Parameters” section of this report for a more detailed explanation.

The tributary and deep spot turbidity was **low** this year, which is good news.

However, we recommend that your group sample the pond and any surface water runoff areas during significant rain events to determine if stormwater runoff contributes turbidity and phosphorus to the

pond.

For a detailed explanation on how to conduct rain event sampling, please refer to the 2002 VLAP Annual Report special topic article, which is posted on the VLAP website at

<http://www.des.nh.gov/organization/divisions/water/wmb/vlap/categories/publications.htm>, or contact the VLAP Coordinator.

➤ **Table 12: Bacteria (*E.coli*)**

Table 12 in Appendix B lists the current year and historical data for bacteria (*E.coli*) testing. *E. coli* is a normal bacterium found in the large intestine of humans and other warm-blooded animals. *E.coli* is used as an indicator organism because it is easily cultured and its presence in the water, in defined amounts, indicates that sewage **may** be present. If sewage is present in the water, potentially harmful disease-causing organisms **may** also be present.

Bacteria sampling was not conducted this year. If residents are concerned about sources of bacteria such as failing septic systems, animal waste, or waterfowl waste, it is best to conduct *E. coli* testing when the water table is high, when beach use is heavy, or immediately after rain events.

➤ **Table 13: Chloride**

Table 13 in Appendix B lists the current year and the historical data for chloride sampling. The chloride ion (Cl^-) is found naturally in some surfacewaters and groundwaters and in high concentrations in seawater. Research has shown that elevated chloride levels can be toxic to freshwater aquatic life. In order to protect freshwater aquatic life in New Hampshire, the state has adopted **acute and chronic** chloride criteria of **860 and 230 mg/L** respectively. The chloride content in New Hampshire lakes is naturally low, generally less than 2 mg/L in surface waters located in remote areas away from habitation. Higher values are generally associated with salted highways and, to a lesser extent, with septic inputs. Please refer to the “Chemical Monitoring Parameters” section of this report for a more detailed explanation.

Chloride sampling was **not** conducted during **2010**.

➤ **Table 14: Current Year Biological and Chemical Raw Data**

Table 14 in Appendix B lists the most current sampling year results. Since the maximum, minimum, and annual mean values for each parameter are not shown on this table, this table displays the current

year “raw,” meaning unprocessed, data. The results are sorted by station, depth, and then parameter.

➤ **Table 15: Station Table**

As of the spring of 2004, all historical and current year VLAP data are included in the DES Environmental Monitoring Database (EMD). To facilitate the transfer of VLAP data into the EMD, a new station identification system had to be developed. While volunteer monitoring groups can still use the sampling station names that they have used in the past and are most familiar with, an EMD station name also exists for each VLAP sampling location. Table 15 in Appendix B identifies what EMD station name corresponds to the station names you have used in the past and will continue to use in the future.

DATA QUALITY ASSURANCE AND CONTROL

Annual Assessment Audit:

During the annual visit to your pond, the biologist conducted a sampling procedures assessment audit for your monitoring group. Specifically, the biologist observed the performance of your monitoring group and completed an assessment audit sheet to document the volunteer monitors’ ability to follow the proper field sampling procedures, as outlined in the VLAP Monitor’s Field Manual. This assessment is used to identify any aspects of sample collection in which volunteer monitors failed to follow proper procedures, and also provides an opportunity for the biologist to retrain the volunteer monitors as necessary. This will ultimately ensure samples that the volunteer monitors collect are truly representative of actual lake and tributary conditions.

Overall, your monitoring group performed **very well** while collecting samples on the annual biologist visit this year! Specifically, the members of your monitoring group followed the majority of the proper field sampling procedures. However, the biologist did identify a few aspects regarding sample collection that the volunteer monitors could improve upon, as follows:

- **Anchoring at deep spot:** Please remember to use an anchor with sufficient weight and a sufficient amount of rope to prevent the boat from drifting while sampling at the deep spot. It is difficult for the biologist to collect an accurate and representative dissolved oxygen/temperature profile when the boat is drifting. In addition, it is difficult to view the Secchi disk and collect samples from the proper

depths when the boat is drifting. Depending on the depth of the pond and the wind conditions, it may be necessary to use two anchors!

USEFUL RESOURCES

Acid Deposition Impacting New Hampshire's Ecosystems, DES fact sheet ARD-32, (603) 271-2975 or
www.des.nh.gov/organization/commissioner/pip/factsheets/ard/documents/ard-32.pdf.

Best Management Practices to Control Nonpoint Source Pollution: A Guide for Citizens and Town Officials, DES Booklet WD-03-42, (603) 271-2975 or
www.des.nh.gov/organization/commissioner/pip/publications/wd/documents/wd-03-42.pdf.

Lake Protection Tips: Some Do's and Don'ts for Maintaining Healthy Lakes, DES fact sheet WD-BB-9, (603) 271-2975 or
www.des.nh.gov/organization/commissioner/pip/factsheets/bb/documents/bb-9.pdf.

NH Stormwater Management Manual Volume 1: Stormwater and Antidegradation, DES fact sheet WD-08-20A, (603) 271-2975 or
<http://des.nh.gov/organization/commissioner/pip/publications/wd/documents/wd-08-20a.pdf>

NH Stormwater Management Manual Volume 2: Post-Construction Best Management Practices Selection and Design, DES fact sheet WD-08-20B, (603) 271-2975 or
<http://des.nh.gov/organization/commissioner/pip/publications/wd/documents/wd-08-20b.pdf>

NH Stormwater Management Manual Volume 3: Erosion and Sediment Controls During Construction, DES fact sheet WD-08-20C, (603) 271-2975 or
<http://des.nh.gov/organization/commissioner/pip/publications/wd/documents/wd-08-20c.pdf>

Proper Lawn Care In the Protected Shoreland, The Comprehensive Shoreland Protection Act, DES fact sheet WD-SP-2, (603) 271-2975 or
<http://des.nh.gov/organization/commissioner/pip/factsheets/sp/documents/sp-2.pdf>.

Weed Watchers: An Association to Halt the Spread of Exotic Aquatic Plants, DES fact sheet WD-BB-4, (603) 271-2975 or
<http://des.nh.gov/organization/commissioner/pip/factsheets/bb/documents/bb-4.pdf>.